USDA

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Animal and
Plant Health
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Service

West Indian Fruit Fly Cooperative Eradication Program

Lower Rio Grande Valley, Texas

Environmental Assessment, October 2000

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I. Introduction

The West Indian fruit fly (or Antillean fruit fly), *Anastrepha obliqua* (Macquart), is an important pest of tropical fruits that is found in Central and South America, the West Indies and nearby Islands. It became established in Florida (Key West, from 1931 to 1937), and has been introduced previously into California and Texas, but it is not established in the United States now.

The West Indian fruit fly is the major pest of mango in most of the new world tropics and, although it infests citrus, citrus does not appear to be an important host. It also infests almond, carambola, cashew, guava, loquat, pear, and sapote. Hog-plum is a wild host that is an important reservoir of infestation.

Commercial and home-grown produce that is attacked by the pest is unfit to eat because the larvae tunnel through the fleshy part of the fruit, damaging the fruit and subjecting it to decay from bacteria and fungi. Because of its potential for damage, a permanent infestation of the West Indian fruit fly would be costly and undesirable to the agricultural economy of the United States.

II. Purpose and Need

West Indian fruit flies have been found recently in fruit groves in the Lower Rio Grande Valley of Texas. One female was detected in a grapefruit grove in Mission (Hidalgo County), Texas, on August 2, 2000. Subsequently, two more adult females were detected in a guava grove in Las Yescas (Cameron County), Texas, on October 3, 2000. Because of the detections of the pest, an infestation of West Indian fruit fly was determined to exist. This infestation represents a serious threat to the agriculture and the environment of Texas and other U.S. mainland States.

The U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), and the Texas Department of Agriculture (TDA) are proposing a program to eradicate the infestation in the Lower Rio Grande Valley. At present, only the Las Yescas detections meet the criteria that require an eradication program, however, the detection in Mission and the close proximity of known infestations of West Indian fruit fly in nearby Mexico present the potential for further introductions of the pest (and resultant need for control) in other areas of the Valley. This environmental assessment analyzes the potential environmental consequences of alternatives for eradication of the West Indian fruit fly in the Lower Rio Grande Valley.

APHIS' authority for cooperation in the program is based upon the Organic Act (7 United States Code (U.S.C.) 147a), which authorizes the Secretary of Agriculture to carry out operations to eradicate insect pests, and the Plant Protection Act (Title 4 of the Agricultural Risk Protection Act of 2000), which authorizes the Secretary of Agriculture to use emergency measures to prevent dissemination of plant pests new to or not widely distributed throughout the United States.

III. Alternatives

A. No Action

Under this alternative, APHIS would not participate in any efforts to eradicate the current infestation of the West Indian fruit fly in the Lower Rio Grande Valley of Texas. An eradication program could proceed under the direction of the State and/or county governments, but the lack of Federal/State coordination would likely jeopardize timely and efficient implementation of the program. This could result in delays in achieving eradication, expansion of the infested area, and permanent establishment of the West Indian fruit fly. Potential adverse environmental effects of this alternative would be at least as severe as those under the proposed integrated program alternative, and would be more severe if the infestation expanded substantially or could not be eradicated. Establishment of the West Indian fruit fly would lead to increased damage to crops and backyard produce, uncoordinated use of insecticides by commercial and backyard growers, and increased environmental risk from the insecticide applications. Such adverse effects would be of an indirect, but continuing and escalating nature.

B. Nonchemical Control

Under this alternative, APHIS would participate in a cooperative program to eradicate the existing infestation of West Indian fruit fly in the Lower Rio Grande Valley of Texas with solely nonchemical methods. Examples of such methods include: physical control, cultural control, male annihilation (mass trapping), and regulatory control. Biological control and biotechnological control are other nonchemical methods that were considered, but have not yet been proven efficacious or technologically feasible. Federal/State approval of such a nonchemical program is unlikely because nonchemical technologies cannot respond quickly enough to the infestation to contain and eliminate it before it has the opportunity to spread. Regulatory treatments (cold treatments, vapor heat treatments, and irradiation treatments) are applicable for some commodities. The potential adverse environmental impacts of a nonchemical program would be expected to be as severe as under the no action alternative, because of the anticipated inability of such a program to quickly and effectively eradicate the infestation. The infestation would grow, resulting in increased damage to crops and backyard produce, uncoordinated use of insecticides by commercial and backyard growers, and increased environmental risk from insecticide applications. Such adverse impacts would be of an indirect, but continuing and escalating nature.

C. Integrated Program (Preferred Alternative)

The proposed integrated program would use any or a combination of control methods, based on site-specific requirements that take into account program efficacy and environmental considerations. A form of integrated pest management, integrated control may include the use of both chemical and nonchemical methods in a timely manner to achieve the program goal of eradication and minimize potential environmental consequences that could arise from program activities. This is the preferred alternative, from both program and environmental perspectives.

The proposed integrated program would use any or a combination of the following methods: (1) chemical control (aerial and/or ground insecticide baits, soil insecticide drenches, and commodity fumigations); (2) physical control (fruit removal and destruction, orchard destruction, cold treatment of commodities, high temperature forced air treatments of commodities, vapor heat treatment of commodities, and irradiation of commodities); (3) cultural controls; and (4) quarantines that restrict the movement of commodities. Biological control, biotechnological control, and sterile insect technique were considered, but have not yet been proven to be efficacious or technologically feasible for this emergency eradication program.

The eradication program is likely to consist of fruit cutting; three applications of malathion or spinosad bait, applied at 6- to10-day intervals; and soil treatments of Diazinon drenched with water into the soil within the drip line of plants with fruit known or suspected to contain West Indian fruit fly larvae. Other control options include the use of mass trapping, host removal, and regulatory control. Regulatory control involves quarantine of fresh produce and commodities from host plants of the West Indian fruit fly. Specific regulatory treatments are required for transport of produce grown within the designated quarantine area to destinations outside this regulated area. The treatment of produce and nursery stock may involve malathion bait spray applications, diazinon soil treatments, or methyl bromide fumigations.

There are potential adverse environmental impacts from the use of chemicals in the integrated program. In general, the integrated program would have direct adverse impacts of a non-continuing nature, but those impacts are fewer and less severe than in the other alternatives.

IV. Affected Environment and Potential Environmental Consequences

A. Affected Environment

The affected environment includes areas of the Lower Rio Grande Valley of Texas that are encompassed by the program's eradication and quarantine zones. The current eradication zone (where eradication treatments will occur) is the area including and immediately surrounding the West Indian fruit fly detections in the vicinity of Las Yescas. The current quarantine zone (where regulatory treatments may be required) includes the eradication zone and extends farther, for a total area of approximately 81 square miles.

In past eradication programs, additional detections occasionally have resulted in program expansion (expansion of eradication and quarantine zones). Minor expansion of the program should not result in the need for further analysis unless unique and different factors (e.g., endangered or threatened species) are found in the new area. Major expansion of the program area would probably result in the need for additional analysis.

The current program area is rural in character, and humans, domestic animals, wildlife, and plants may be found in the program area. Because of the presence of groundwater within the program area, preservation of water quality is of concern. The proposed program is also in close proximity to the Laguna Atascosa National Wildlife Refuge.

Section 7 of the Endangered Species Act of 1973 (ESA) requires Federal agencies to consult with the U.S. Department of the Interior, Fish and Wildlife Service (FWS), if species listed or proposed for listing are likely to be adversely affected. APHIS is consulting with FWS and will conclude that consultation before a finding is reached. Although no endangered or threatened species are known to exist within the infested groves, there is concern for protection of these species within the current eradication zone and in other surrounding areas of the counties. If the program expands into other areas of the counties, and if there is a potential for affecting federally listed or proposed endangered and threatened species, APHIS will consult further with FWS over protective measures that may be required.

B. Potential Environmental Consequences

The analysis of potential environmental consequences will consider the alternatives of no action, nonchemical control, and an integrated program. Because the principal environmental concern over this program relates to its use of chemical pesticides, this assessment focuses on the potential environmental consequences of the program pesticides on human health, nontarget species, and endangered and threatened species.

Consistent with Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," APHIS considered the potential for disproportionately high and adverse human health or environmental effects on any minority populations and low-income populations. In particular, APHIS considered the potential for adverse effects to the low-income residents of certain subdivisions (colonias) near treatment areas. Standard operating procedures and mitigation measures are applied to prevent adverse effects to these residents. No disproportionate effects on such populations are anticipated as a consequence of implementing the preferred alternative.

APHIS also considered requirements under Executive Order 13045 regarding "Protection of Children From Environmental Health Risks and Safety Risks." The standard operating procedures and mitigation measures of this program are designed to minimize exposure of the general public. The required use of safety equipment and procedures by program personnel preclude human exposures that could result in disproportionate adverse effects to children.

1. No Action

Under the no action (no APHIS effort) alternative, West Indian fruit fly control would be left to the State, grower groups, or individuals. Without a coordinated APHIS effort, including use of control methods not generally available (e.g., sterile insects), it is likely that the West Indian fruit fly infestation would spread to other areas of Texas and the U.S. mainland. Efforts to control such an expanded infestation by individuals or organizations would probably result in a greater magnitude of environmental impact than would be associated with a coordinated APHIS/State eradication program. Under such conditions, any available controls (including more hazardous chemical pesticides) could be used, resulting in greater environmental impact than is associated with the action alternatives analyzed within this assessment.

a. Human Health

Under the no action alternative, private homeowners and commercial growers would have few options other than pesticides to reduce the West Indian fruit fly damage to their crops. Any pesticides registered for use could be applied in an unsupervised and uncoordinated manner. Accordingly, greater pesticide amounts and higher frequencies of application are likely to be used than would be expected with a coordinated, cooperative government program. In addition to the direct toxic effects of those pesticides, humans could also be affected by cumulative impacts resulting from synergistic effects of combining various pesticides for use against West Indian fruit fly. Human exposure to pesticides and resulting adverse consequences probably would be greater than if pesticides were applied in a cooperative government program. The spread of the West Indian fruit fly infestation will reduce the amount of locally available produce and may restrict the fruit consumption of some members of the public. Some members of the public may depend upon this source of fruit as a substantial portion of their diet.

b. Nontarget Species

Broader pesticide use resulting from lack of APHIS effort to combat West Indian fruit fly would increase the pesticide load to the environment and, therefore, increase the probability of effects to nontarget species. The potential expansion and establishment of the pest also would have unknown effects on insect community structure and on predators in those systems.

c. Endangered and Threatened Species

Further expansion of West Indian fruit fly's range would be likely to include endangered and threatened species habitats, with unquantified risk to those species from uncoordinated pesticide use. No adverse impacts to endangered or threatened species would result directly from APHIS' implementation of the no action alternative.

2. Nonchemical Control

The nonchemical control methods proposed for use under this alternative include physical control, cultural control, male annihilation (mass trapping), and regulatory control. Although biological control and biotechnological control are the subjects of research, these methods have not yet been proven efficacious or technologically feasible, so their potential environmental consequences are not analyzed.

a. Human Health

Under the nonchemical control alternative, human health is not expected to be adversely affected. The nonchemical control methods do not pose a risk to human health. The control program includes some regulatory treatments (cold treatments, irradiation, and vapor heat treatments) that occur in restricted access facilities and that are strictly supervised to ensure no effects occur to human health. The nonchemical control alternative may not be successful for larger infestations and the consequences of inadequate control could be comparable to the no action alternative if the infestation of West Indian fruit fly expanded due to insufficient containment of the pest.

b. Nontarget Species

The nonchemical techniques that may be employed could cause physical disturbance to nontarget species due to noise or mere human presence. In general, little risk is associated with these disturbances. Nonchemical methods have the potential for less pesticide use than the other alternatives, but control and containment by this alternative depend upon low pest populations. If nonchemical methods were insufficient to eradicate a pest population, the ultimate expansion of the infestation could result in pesticide usage comparable to that of no action.

c. Endangered and Threatened Species

Nonchemical methods should not directly impact endangered or threatened species. The treatments are not made to these species or their critical habitats. Cultural and physical control methods can affect some species through habitat disturbance, but consultation with FWS about the use of these methods within program areas is made prior to program action to ensure that no program's actions will affect the endangered or threatened species or their critical habitat.

3. Integrated Program (Preferred Alternative)

The environmental consequences of nonchemical methods were discussed under the nonchemical control alternative and will not be repeated in this section. The components of the proposed program which potentially have the greatest impact on the environment are the chemical pesticides. Special registration procedures are required for pesticides used against exotic pests, such as the West Indian fruit fly, that are not native to this country. A section 18 (emergency) or section 24c (special local needs) exemption under the Federal Insecticide, Fungicide, and Rodenticide Act allows their use.

The environmental consequences from the use of these pesticides (malathion, spinosad, diazinon, and methyl bromide) are discussed below. Three major factors influence the risk associated with pesticide use: fate of the pesticide in the environment, its toxicity to humans and nontarget species, and the exposure of humans and nontarget species to the pesticide. These factors will be evaluated for each of the chemicals analyzed.

a. Malathion Bait Spray

(1) Fate

Malathion is an amber-colored liquid that is combined with a protein bait to form a sticky spray. The formulation used in the program is 0.175 pounds of active ingredient per acre mixed with 9.6 fluid ounces of protein hydrolysate bait per acre, for both aerial and ground applications. The half-life of malathion in soil or on foliage ranges from 1 to 6 days; and in water, from 6 to 18 days. Malathion bait spray is applied from the ground, generally as a spot treatment to individual trees, or from the air. Trees, shrubs, and other surfaces such as soil, roads, and ponds are likely to receive spray from aerial applications, although efforts are made to avoid directly spraying water bodies, including the use of buffers. Malathion is generally of more concern in aquatic areas because of its high toxicity to aquatic organisms.

(2) Toxicity

Malathion is an organophosphate that acts by inhibiting acetylcholinesterase. Mildly acutely toxic, malathion is classified by EPA as category III (Caution) based on oral, dermal, and inhalation exposure routes. Toxic effects from malathion may include headache, nausea, vomiting, blurred vision, weakness, and muscular twitching at high doses. In humans and other mammals, metabolism by one degradation pathway leads to the formation of malaoxon, a more potent cholinesterase inhibitor than malathion. The more common degradation pathways yield nontoxic intermediates.

Although malathion has not been determined to be a carcinogen in rats, additional data on malathion and malaoxon are considered equivocal and studies are ongoing. EPA is currently reviewing this issue and expected to provide a revised ruling on the carcinogenic potential of malathion later this year. The predominance of studies indicate that malathion is not genotoxic or mutagenic. More information is needed to determine the neurotoxicity of malathion (EPA, 1988). Malathion may have synergistic effects when used with other pesticides.

Oral doses of malathion are slightly to moderately acutely toxic to mammals and birds (table 1). Signs of poisoning are similar to the reactions of humans. Malathion is highly toxic to some forms of aquatic life, including invertebrates, amphibians, and fish (table 2). The EPA has established a chronic water quality criteria of 0.1 µg/L (micrograms per liter) for protection of freshwater and marine aquatic life. Fish kills that may have been associated with aerial malathion bait spray applications have been documented.

Table 1. Acute Oral LD_{50}s[1] for Selected Species Dosed with Malathion (mg/kg)[2]

Mouse	720 - 4,060
Female rat	1,000
Male rat	1,375
Mallard	1,485
Pheasant	167

[1]LD_{50} = Lethal dose for 50% of animals treated

Table 2. Malathion 96-hour LC_{50}s[1] for Selected Aquatic Species (µg/L)

Tadpole	200
Rainbow trout	4.1 - 200
Bluegill	20 - 110
Daphnia	1 - 1.8
Stone flies	1.1 - 8.8

[1]LC_{50} = Lethal concentration for 50% of animals treated

(3) Exposure and Risk

Human Health

Potential exposure to humans is by dermal absorption, inhalation, or ingestion of residues. Due to the potential for aerial application of malathion bait spray, dermal absorption from direct application or contact with treated surfaces is the primary exposure route for the public. Public exposure from a ground malathion bait spray application will be smaller than exposure from an aerial application because less area is treated and less pesticide is used. Workers, such as ground applicators and the ground crew for aerial applications, may have inhalation exposure as well as dermal exposure.

Results of the quantitative risk assessment prepared for the Medfly Cooperative Eradication Program Environmental Impact Statement (EIS), whose analysis of malathion impacts also applies to West Indian fruit fly programs, suggest that exposures to pesticides from comparable program operations are not likely to result in substantial adverse human health effects. Residues on commodities or backyard fruits resulting from the malathion bait spray application are unlikely to greatly increase exposure to the consuming public. Malathion concentrations on vegetation estimated by the California Department of Health Services (Kizer, 1991) indicate that levels of malathion on vegetation are not likely to exceed the residue tolerance levels set by EPA. Residue tolerances for malathion on many food items are established (40 CFR 180.11) and most are 8 parts per million (ppm). The provisional acceptable daily intake is 0.02 mg/kg per day.

The human health risks of comparable treatments are evaluated quantitatively in the Medfly Cooperative Eradication Program EIS. Results suggest that exposure from normal program operations will not present a human health risk either to workers or the public. In addition, risks to humans have been analyzed qualitatively, with reliance on information from past fruit fly eradication programs. The exposure scenarios from previous fruit fly eradication efforts will not differ substantially from the current program.

Nontarget Species

Malathion bait spray will kill insects other than the West Indian fruit fly. Malathion is highly toxic to bees, and direct application to areas of blooming plants can be expected to result in a high bee kill. Although malathion is not phytotoxic, there could be potential indirect effects on plant populations due to lower pollination rates if bee or other pollinator populations are reduced. This is a concern of aerial application. Secondary pest outbreaks have occurred concurrently with the use of aerial applications of malathion bait spray, but have not been determined conclusively to be associated with the applications.

Terrestrial animals are exposed to malathion primarily through dermal and oral routes. Ingesting prey containing residues, rubbing against treated vegetation, and grooming contribute to total dose. Aquatic species can be exposed to direct application and runoff. Exposure of malathion bait spray by aerial application poses high risk to nontarget invertebrates and some aquatic species. Some insectivores may be affected. Ground application of malathion bait spray has far fewer environmental consequences because the treated area is smaller and delivery is more accurate. Fewer species would be exposed and thus the treatment poses less total risk to nontarget species than does aerial application.

Endangered and Threatened Species

Although no endangered or threatened species are found within the current program treatment zone, several endangered or threatened species are found in the Lower Rio Grande Valley. If the program were to expand and if the range of federally listed species and the treatment area overlapped, protective measures may be required to protect species from adverse environmental consequences of the program. The species that may be affected by control efforts are dependent upon the control methods used (i.e., not all control methods affect all species equally). Thus, protective measures will vary depending on the control method being used and the species found within the treatment area.

Malathion bait spray is not selective for West Indian fruit fly alone. Ingestion of bait/malathion and cuticular exposure to malathion by insects other than West Indian fruit fly could result in their deaths. If their habitats overlapped with the program treatments, those species could be adversely affected by aerial application of malathion bait; thus, elimination of aerial application is a protective measure.

Additionally, repeated aerial sprays of malathion bait generally would reduce insect numbers. Reduction of insect populations could reduce pollinator species for threatened and endangered plants, and would reduce potential food resources for endangered and threatened insectivores. Malathion is highly toxic to many aquatic species, both vertebrate and invertebrate, and spray drift could result in aquatic system disruption. The ecosystem is resilient enough to absorb some reduction in nontarget populations and the resultant food web effects, but the severity of the reductions would increase with increased applications of malathion. Many of the endangered and threatened species are dependent upon aquatic habitats. Loss of a single individual of a listed species from program activities would be a violation of ESA. Thus, aerial application of malathion bait spray should be controlled both within the range of endangered and threatened insect-pollinated plants (especially annuals) and in aquatic habitats.

b. Spinosad Bait Spray

(1) Fate

Spinosad is a mixture of macrocyclic lactones produced naturally by an actinomycete bacteria. The active ingredients in spinosad are spinosyn A and spinosyn D. The bait formulation includes sugars and attractants that are of low toxicity and do not contribute to the overall hazard, but these substances may decrease the rate of degradation, particularly photodegradation by blocking the penetration of sunlight. The actual concentration of spinosad used by the program in the bait spray formulation is very low (0.008%).

Spinosad is registered for use on various crops and has permanent EPA-approved tolerances for some fruits (including citrus), nuts, vegetables, cotton, and meat.

Thorough risk assessments have been prepared for human health (USDA, APHIS, 1999a) and nontarget species (USDA, APHIS, 1999b) for spinosad bait spray applications. Information from those assessments is incorporated by reference into this document and is summarized here.

The hazards of spinosad to environmental quality are minimal. This is primarily a function of the environmental fate. Spinosad persists for only a few hours in air and water. The low vapor pressure of spinosad indicates that it is not volatile. The aerobic soil half-life of both spinosyn A and D is 14.5 days. The photolysis half-life in soil is 8.68 days for spinosyn A and 9.44 days for spinosyn D (Dow Agrosciences, 1998). Although spinosyn A is water soluble, the compound readily binds to organic matter and no leaching to groundwater is anticipated for either spinosyn. The spinosyns bind readily to organic matter on leaf surfaces also. The photodegradation of spinosad residues occurs readily on plants and tolerances on crops are not of great concern to EPA (EPA, 1998a). The rapid breakdown and lack of movement in the environment ensure that there will be no permanent effects on the quality of air, soil, and water for the program applications.

(2) Toxicity

Spinosad acts as a contact and stomach poison against insects and it is particularly effective against all stages of flies (Adan et al., 1996). The mode of toxic action of this compound against insects has been shown to relate to the widespread excitation of isolated neurons in the central nervous system (Salgado et al., 1997). This is caused by persistent activation of nicotinic acetylcholine receptors and prolongation of acetylcholine responses. The symptoms of intoxication are unique and are typified by initial flaccid paralysis followed by weak tremors and continuous movement of crochets and mandibles (Thompson et al., 1995). The receptors affected by spinosyns in insects are not present or vital to nerve transmission in most other taxa, so toxicity to most other organisms is low. There have been no reported human illnesses from the manufacturing or pesticide applications of spinosad.

Acute hazards from exposure to spinosad are low to mammals by all routes of exposure. The acute oral LD_{50} to rats is greater than 5,000 milligrams (mg) of spinosad per kilogram (kg) body weight (Dow Agrosciences, 1998; EPA, 1998a). The acute dermal LD_{50} to rats is greater than 2,800 mg/kg.

Primary eye irritation tests in rabbits showed slight conjunctival irritation. Primary dermal irritation studies in rabbits showed slight transient erythema and edema. Spinosad was not found to be a skin sensitizer.

Subchronic and chronic studies also indicate low hazard. The systemic NOEL for spinosad from chronic feeding of dogs was determined to be 2.68 mg/kg/day (EPA, 1998a). The LOEL for this study (8.22 mg/kg/day) was based upon vacuolated cells in glands (parathyroid) and lymphatic tissues, arteritis, and increases in serum enzymes. The regulatory reference values selected for spinosad are based upon this study applying a safety factor of 10 for occupational exposure to make allowance for inter-species variability. An additional safety factor of 10 was applied for general public exposure to make allowance for intra-species variability and potential for wider ranges in sensitivity in the general public than in the occupational population. A neuropathology NOEL of 46 mg/kg/day was determined for male rats. EPA has classified the carcinogenic potential of spinosad as Group E - no evidence of carcinogenicity based upon chronic studies of mice and rats (EPA, 1998b). There has been no evidence of mutagenic effects from spinosad. The reproductive NOEL from a 2-generation study of rats was determined to be 10 mg/kg/day (EPA, 1998a).

The primary active ingredients in spinosad are spinosyn factor A and spinosyn factor D. All other substances in the formulated products of spinosad are of lower toxicity. Spinosyns are relatively inert and their metabolism in rats resulted in either parent compound or – and O- demethylated glutathione conjugates as excretory products (EPA, 1998a). Studies have found that 95% of the spinosad residues in rats are eliminated within 24 hours.

Acute oral doses of spinosad are very slightly toxic to mammals and practically nontoxic to birds (table 3). Spinosad is slightly to moderately toxic to fish and most aquatic invertebrates, but highly toxic to marine molluscs (table 4). Spinosad is of slight to moderate acute toxicity to algae.

Table 3. Acute Oral LD_{50}s[1] for Selected Species Dosed with Spinosad (mg/kg)[2]

Rat	>5,000
Mouse	23,100
Shrew	3,400
Mallard	>2,000
Pheasant	>2,000

[1]LD_{50} = Lethal dose for 50% of animals treated

Table 4. Spinosad 96-hour $LC_{50}s^{1}$ for Selected Aquatic Species (µg/L)

Grass shrimp	9,760
Rainbow trout	30,000
Bluegill	5,900
Daphnia	92,600
Eastern oyster	295

[1] LC_{50} = Lethal concentration for 50% of animals treated

(3) Exposure and Risk

Human Health

Potential exposure to humans is by dermal absorption, inhalation, or ingestion of residues. Dermal contact with treated surfaces is the primary exposure route for the public. Public exposure from ground bait spray application is less than exposure from an aerial application because less area is treated and less pesticide is used. Workers, such as ground applicators and the ground crew for aerial applications, may have inhalation exposure as well as dermal exposure.

Results of the quantitative risk assessment prepared for spinosad bait spray applications suggest that potential exposures are not likely to result in substantial adverse human health effects. The highest potential occupational exposure was determined to occur in the extreme exposure scenario for ground personnel. The margin of safety for these program workers is about 100-fold. The highest potential exposure to spinosad for the general public occurs in the extreme scenario of a child consuming contaminated runoff water. The margin of safety for this individual exceeds 1,000-fold. No adverse effects are anticipated to human health from spinosad bait spray applications, even under extreme or accidental exposure scenarios.

Risks to human health from spinosad bait spray applications were also analyzed qualitatively for some chronic and subchronic effects. Since EPA has determined that there is no evidence of mutagenicity or any carcinogenic potential for spinosad, these outcomes are not expected to be of any concern. Most of the potential outcomes tested in laboratory tests required much higher exposures than would be anticipated from program applications. Outcomes such as reproductive and developmental toxicity, teratogenicity, and neurotoxicity are highly unlikely to occur from exposures to program applications. Spinosad is not a skin sensitizer, but other immunotoxic responses could occur if allergic reactions or hypersensitive conditions exist. Based upon experience in past programs, it must be kept in mind that the source of any immunotoxic responses to exposure may relate to a reaction to the bait in the formulation rather than the pesticide.

Nontarget Species

The estimated doses to wildlife are based on the environmental concentrations determined from exposure models and scenarios. These results are described in greater detail in the nontarget risk assessment (USDA, APHIS, 1999b). The exposure of nontarget organisms to spinosad from bait spray applications is lower than to malathion. As a result of low exposure and low toxicity, the potential for adverse effects is expected to be negligible to mammals, birds, reptiles, fish, and amphibians from spinosad bait spray applications. Unlike malathion (toxic to all organisms by all routes of exposure), the active ingredients in spinosad are only toxic to certain invertebrates primarily by dermal and oral exposure. Any invertebrate that is attracted to and feeds upon the spinosad bait will be affected, but most species are not attracted to the bait. A small number of phytophagous invertebrates (particularly Lepidoptera caterpillars) may be killed by consumption of residues on leaves from spinosad bait spray applications. Predatory invertebrates in treated areas are not expected to have much mortality. Although spinosad bait spray is not attractive to honey bees, their susceptibility to spinosad toxicity is high and direct application to areas of blooming plants can be expected to result in a high bee kill.

Aquatic species are at very low risk of adverse effects. The calculated concentration of spinosad in water is several orders of magnitude less than any concentration known to adversely affect aquatic organisms. Residues of spinosad are not expected to bioconcentrate based upon the water solubility and short residual half-life in water.

Endangered and Threatened Species

Although no endangered or threatened species are known to reside within the current program eradication zone, several endangered or threatened species are found in Cameron County and other areas of the Lower Rio Grande Valley. If the program were to expand and if the range of federally listed species and the treatment area overlapped, protective measures may be required to protect species from adverse environmental consequences of the program. The species that could require protection during control efforts are dependent upon the control methods used (i.e., not all control methods affect all species equally). Thus, protective measures will vary depending on the control method being used and the species found within the treatment area.

Spinosad bait spray is not selective for the West Indian fruit fly alone. Ingestion of spinosad by insects other than the West Indian fruit fly could result in their deaths. If their habitats overlapped with the program treatments, those species could be adversely affected by aerial application of spinosad bait. Repeated aerial sprays of spinosad bait generally would reduce insect numbers. Reduction of insect populations could reduce pollinator species for threatened and endangered plants, and would reduce potential food resources for endangered and threatened insectivores. Spinosad is not expected to affect any aquatic species or habitats, but potential effects to susceptible terrestrial invertebrates and their habitats must be considered if endangered and threatened species are present.

c. Diazinon Soil Treatments

(1) Fate

Technical grade diazinon is a sweet, aromatic, amber-brown liquid. The program formulation is applied at a rate of 5 pounds active ingredient per acre. Its half-life in soil ranges from 1.5 to 10 weeks, and in water at neutral pH ranges from 8 to 9 days. Small amounts of diazinon are used to treat soil within the drip line of trees that have fruit infested with West Indian fruit fly larvae. Surface vegetation may retain residues and, depending on soil type, local hydrology, and topography, diazinon may occur in runoff water.

(2) Toxicity

Although diazinon is widely used and generally is not considered a hazard to human health under its registered uses, it can be toxic to humans. EPA has classified the formulation of diazinon as category II (Warning) for program use in soil treatment. Although not a primary dermal or eye irritant, it can be absorbed through these routes and, at high concentrations or prolonged exposure, causes severe irritation.

The mode of toxic action of diazinon occurs through inhibition of the enzyme, acetylcholinesterase. Symptoms of poisoning in humans, who are much less susceptible to the effects of diazinon than insects, include dizziness, headache, blurred vision, nausea, vomiting, slurred speech, and mental confusion. Death, which can occur from high doses, results from respiratory arrest caused by muscle paralysis and bronchoconstriction. Accidental oral poisonings have resulted in death from doses between 50 and 500 mg/kg.

Diazinon has many metabolites, but toxicity data on most are not currently available. While the metabolite diazoxon is more toxic than diazinon, it is also more easily metabolized and excreted. Diazinon may exhibit synergistic effects with other commercial pesticide formulations currently in use. Diazinon is not considered to be a carcinogen and is nonmutagenic.

Animals differ in their sensitivity to diazinon, both within and between species. Toxicity varies widely and depends on sex and life stage (table 5). Diazinon is toxic to vertebrate laboratory animals and very toxic to livestock. Diazinon is extremely toxic to birds, which are sensitive because their blood has no enzymes to hydrolyze diazoxon (a toxic metabolite), as does mammalian blood (Eisler, 1986). Signs of intoxication include salivation, stiff-legged gaits, wing spasms, and wing-beat convulsions (Hudson et al., 1984). Many incidents of avian (particularly geese and other waterfowl) mortality on golf courses have occurred because of the use of granular formulations of diazinon. These incidents led EPA to cancel use of diazinon on golf courses and sod farms in 1986. Some terrestrial invertebrates (such as bees) are extremely sensitive to diazinon. Diazinon causes high earthworm mortality but does not have a similar effect on nematodes.

Table 5. Acute Oral LD_{50}s[1] for Selected Species Dosed with Diazinon (mg/kg)

Rabbit	130
Mouse	80 -135
Female rat	76 - 250
Male rat	108 - 285
Guinea pig	280
Calf	0.5
Starling	110
Mallard (3 to 4 months old)	3.5
Pheasant (3 to 4 months old)	4.3
Bobwhite quail	3.4 - 10
Chicken (5 days old)	8.4
Redwinged blackbird	2.0
Butterfly	8.8
Honey bee	0.372/bee

[1]LD_{50} = Lethal dose for 50% of animals treated

Freshwater cladocerans (water fleas, common to aquatic areas) are among the aquatic species most sensitive to diazinon; *Gammarus fasciatus* has a 96-hour

LC_{50} of 0.20 grams per liter. There is some evidence that juvenile fish are more sensitive than eggs. Sublethal effects include reduced growth and reproduction in both marine and freshwater invertebrates, including reduced emergence of insects (Eisler, 1986). Algae are unaffected by concentrations fatal to aquatic invertebrates.

(3) Exposure and Risk

Humans

Potential exposure to humans is by ingestion or dermal absorption. The soil drenching application (rate of 52 mg per square foot of treated area) techniques prevent inhalation exposure. Because the diazinon is watered into the soil and the drenched area is small, public exposure will be limited. Program use of the pesticide precludes exposure to residues from produce on host plants because any fruit will be stripped from the plants before treatment. Occupational exposure will be reduced by wearing gloves when handling or applying diazinon. The only human health risk associated with diazinon is the consumption of soil from the drenched area by toddlers. The public will be notified when a drench has occurred and will be advised of the necessary precautions.

Nontarget Species

Diazinon exposure to nontarget organisms is restricted to those organisms that traverse or visit the treated area as well as relatively immobile species that inhabit the area directly treated. The treatments are limited (generally less than 10 gallons per year) and occur only within the drip line of host trees. However, due to diazinon's high toxicity, organisms that are directly exposed are at high risk. Limiting exposure will reduce this risk.

Endangered and Threatened Species

Because birds are highly mobile and are among the most sensitive vertebrates to diazinon, endangered and threatened avian species are of special concern. No endangered or threatened species are known to exist within the current eradication zone. However, if the program were to expand, the limited nature of the soil treatments and implementation of appropriate protective measures would combine to protect federally listed endangered and threatened bird species.

Diazinon is used only to treat soil under hosts that are infested with West Indian fruit fly larvae. This means that very little is used in a program (usually less than 10 pounds annually, for a combined area of under 2 acres). Therefore, it is unlikely that endangered and threatened birds would even encounter any treatments.

Endangered and threatened birds may be protected from exposure to diazinon by presence of program personnel who remain in the area until the pesticide has soaked into the soil. Program monitoring may include carcass searches to ensure that no endangered and threatened species are affected by the program. If there is any confirmation that the program has adversely affected an endangered and threatened species, immediate action would be taken to determine an appropriate program response that would be required to protect those species.

It is anticipated that swift initiation of eradication activities upon detection of a West Indian fruit fly infestation will minimize the area requiring treatment and make it unlikely that treatments will occur where endangered and threatened species are present. The West Indian fruit fly infestations have occurred in urban and suburban areas where natural areas are small and endangered and threatened species are few or absent. Additionally, the incorporation of protective measures should further protect endangered and threatened species from potential adverse effects attributable to program eradication activities.

d. Methyl Bromide Fumigation

(1) Fate

Methyl bromide is an odorless, colorless, volatile gas which is three times as heavy as air. Its half-life is 3 to 7 days. Methyl bromide is released when a fumigation chamber is aerated. Because methyl bromide is heavier than air, the gas can collect in isolated pockets, which could create hazardous conditions when there is little air circulation or mixing, such as during thermal inversions or periods of low wind.

(2) Toxicity

Methyl bromide gas and liquid are acutely toxic to humans. Contact with liquid or vapors can cause serious skin or eye injury. Inhalation can cause acute illness, including pulmonary edema (fluid buildup in the lungs), gastrointestinal distress, and convulsions which can be fatal. The LD_{50} (lethal dose for 50% of animals treated) of rats to methyl bromide is 2,700 ppm for a 30-minute exposure. In humans, 1,583 ppm (6.2 mg/L (milligrams per liter)) methyl bromide is lethal after 10 to 20 hours of exposure and 7,890 ppm (30.9 mg/L) is lethal after 1½ hours of exposure (EPA, 1986).

EPA has derived a reference concentration (RfC) of 0.48 mg/m^3 (milligrams per cubic meter) for general population exposure to methyl bromide (EPA, 1992). Methyl bromide is rapidly absorbed by the lungs and affects both the lungs and kidneys. Increased exposure to methyl bromide results in elevation of bromine levels in the blood; poisoning symptoms occur at a level of 2.8 mg/100 ml of blood (Curley, 1984). Symptoms of acute exposure typically are headache, dizziness, visual problems, gastrointestinal disturbances, and respiratory problems. In more extreme cases, muscular pain, numbness, or twitching precede convulsions, unconsciousness, and possibly death.

Chronic exposure can result in behavioral changes, loss of ability to walk, neurological damage, and renal and liver function disturbances (Verberk et al., 1979). Because there are a number of toxicity data gaps, the chronic and subchronic toxicity of methyl bromide is not well characterized. For this reason, and the implication of its contribution to ozone depletion, EPA has issued a call-in notice to provide this information for reregistration. Manufacturers must supply more information.

Based on laboratory studies of the effects of methyl bromide inhalation and ingestion, nontarget species of mammals and birds exhibit symptoms similar to humans: weakness, lack of muscular coordination, neurological and behavioral abnormalities, and death from high doses. Due to its restricted use as a fumigant, wild animals are rarely exposed to methyl bromide and toxicity data is limited to farm animals. Residues in hay ranging from 6,800 to 8,400 ppm caused symptoms of intoxication in cattle, horses, and goats (Knight and Costner, 1977).

(3) Exposure and Risk

Humans

Inhalation is the primary exposure route for methyl bromide. Concentrations of methyl bromide are electronically monitored during the fumigation. Because the gas is odorless and nonirritating during exposure and the onset of symptoms is delayed, leaks and spills causing extreme exposure can occur without persons being aware of its presence. Protective clothing and self-contained breathing apparatus are worn whenever concentrations of methyl bromide are anticipated to reach or exceed 5 ppm. The American Conference of Governmental Industrial Hygienists (ACGIH) has established exposure standards (threshold limit value) of 5 ppm (20 mg/m^3) to protect against adverse neurotoxic and pulmonary effects (ACGIH, 1990). Dermal exposure to workers could occur in the unlikely event of a spill of liquid methyl bromide.

Ingestion of methyl bromide residues and its degradation products is a third exposure route. Following aeration of the commodity, the small amount of methyl bromide that remains dissipates and degrades, leaving only inorganic bromide residues. However, residues from the methyl bromide fumigation will remain on the commodity. EPA tolerances for residues of methyl bromide, measured as inorganic bromides (40 CFR 180.123), range from 5 ppm (for apples, pears, and quinces) to 240 ppm (for popcorn), with most commodities at 50 ppm or less. Ingestion of these small amounts of residues is considered to have no toxicological effect.

The Natural Resources Defense Council previously petitioned EPA to classify methyl bromide as a class I ozone depleting chemical; the petitioners also requested reduction of its manufacture by 50% in 1992, and complete elimination of manufacture by January 1, 1993. EPA is expected to require phase out of most uses of methyl bromide by 2005. The relative importance of methyl bromide to ozone depletion, however, is subject to fundamental uncertainties.

Workers will have little exposure to methyl bromide because fumigations are contained. The public will be restricted from access to the fumigation chamber by a 30-foot wide barrier zone. Residues in fumigated commodities will be within tolerance limits. There is very little risk to human health from a methyl bromide fumigation.

Nontarget Species

Few nontarget species will be exposed to methyl bromide directly. The aeration duct will deliver a plume which will disperse quickly. Species within this plume, such as insects which inadvertently fly in, might die. However, these effects are restricted to areas within the 30-foot wide barrier zone (Bergsten, personal communication). In addition, ground-dwelling organisms immediately outside the fumigation chamber are not anticipated to survive.

Endangered and Threatened Species

Fumigation chambers are generally located in high traffic areas; tarped fumigations occur in agricultural areas. These areas are highly disturbed and are very unlikely to harbor endangered and threatened species. Therefore, it is not likely that endangered or threatened species will be exposed to methyl bromide fumigation.

e. Cumulative Impacts

Cumulative impacts are those impacts, either direct or indirect, that result from incremental impact of the program action when added to other past, present, and reasonably foreseeable future actions. It is difficult to quantitatively predict the cumulative impacts for a potential emergency program in an environmental assessment such as this. The impacts can be considered from a subjective perspective.

Some chemicals, when used together, have been shown to act in a manner that produces greater toxicity than would be expected from the addition of both. This effect is known as potentiation or synergism. Malathion bait spray and diazinon could be applied during the same treatment regimen. Because malathion has frequently been observed as one constituent of a potentiating pair of organophosphorus insecticides (Murphy, 1980), synergistic effects from the combination of malathion and diazinon (both organophosphorus insecticides) could occur. However, malathion bait spray is applied to the tree canopy and diazinon to the soil within the drip line of the canopy, so synergistic effects are limited to animals that are active on both foliage and soil. In addition, the restriction of diazinon treatments to plants with infested fruits make it unlikely that any animals would get concurrent exposure to both insecticides. The mechanism of toxic action of spinosad is unique and different from other registered agrochemicals. It is, therefore, unlikely that synergism or potentiation of the toxicity of spinosad could occur through exposure to other chemicals.

Impacts from implementation of the program are expected to be temporary with potential adverse effects ending shortly after the infestation is eradicated. No bioaccumulation or environmental accumulation of malathion, diazinon, or spinosad is foreseen due to its rapid degradation rates. In contrast, the ongoing applications expected from the no action alternative would be expected to have cumulative effects. Therefore, any cumulative impacts of the program are expected to be less than those that might occur under the no action alternative, an alternative which most likely would result in escalating use of pesticides by the public.

Because the eradication may require the simultaneous use of malathion bait spray and diazinon, both of which are organophosphate cholinesterase inhibitors, there could be cumulative effects of using two pesticides. The history of the eradication efforts for the West Indian fruit fly, as well as other fruit fly species, shows that this use pattern does not result in adverse effects to the general resident population nor the workers. Because most nontarget species are mobile, it is unlikely that an individual will be exposed to more than one treatment. In addition, diazinon treatments are restricted to locations where West Indian fruit fly larvae are detected. Domestic animals and less mobile organisms, such as those dwelling near the soil surface, could be exposed.

In terms of the cumulative effects of pesticide use from the proposed action with pesticide use from other fruit fly programs, the small region requiring treatment for this program should not substantially increase exposure to workers, public, or nontarget species.

f. Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires each Federal agency to make achieving environmental justice part of its mission. Agencies must identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions.

The potential effects of the proposed program on minority or low-income populations were considered by APHIS. The presence of *colonias* (housing developments, often with low-income Spanish-speaking only residents) in close proximity to or within treatment areas, warrants special attention. Although the proposed West Indian Fruit Fly Cooperative Eradication Program's regulatory and control actions are based on confirmed detections of the pest and specifically target infestations, the residents of those communities could misinterpret the government actions as discrimination because other surrounding communities would not be affected.

Although an unchecked infestation of West Indian fruit fly would reduce the quality and quantity of the consumption of home-grown fruit, the condemnation and seizure of fruit that is valuable to residents from economic and cultural perspectives could be viewed as an objectionable adverse action and may require unusual justification. Program managers should become aware of ethnic sensitivities and respond in an appropriate, responsible manner. Past experience for similar programs, however, suggests that residents usually understand and support the government's actions to eliminate pest infestations.

Special concerns exist relative to the potential pesticide impacts on the residents of minority and low-income populations, such as those in colonias. Language barriers could prevent or reduce the comprehension of communications and notices regarding health risks (special precautions, re-entry periods, etc.). Accordingly, all program communications to the public (proceedings of meetings, pamphlets, letters, appointments, notifications, and warnings) should be translated and published in bilingual format. In particular, new infestations or expansions of program areas should be communicated so that all potentially-affected people can understand. Local, bilingual personnel are recommended for, and typically used, in programs such as this.

g. Methods to Reduce Risk

Human pesticide exposure would be primarily to workers, especially in the case of the soil drench pesticide, diazinon, or methyl bromide which is used only in certified fumigation chambers or under tarpaulins (enclosures). Residents within the eradication area will be exposed to malathion or spinosad bait spray and diazinon to an extent depending on where the pesticides are applied. The public could be exposed to residues on any treated material moved out of the eradication area.

Current worker safety measures protect fumigators and other pesticide applicators from excessive exposure to methyl bromide, diazinon, malathion, and spinosad during routine operations. To minimize worker exposure to methyl bromide, the fumigation chamber is opened only after concentrations are reduced below 5 ppm. Proper sealing of fumigation enclosures and proper aeration facilitates dispersal of the fumigant. Diazinon exposure of workers can be prevented by gloves and safety goggles, which are indicated as protective clothing requirements on the label (Meister, 1990). Studies on exposure to diazinon during yard applications reveal that 85% of the exposure to workers is to their hands. Dermal exposure of workers to malathion or spinosad can also be substantially reduced by the use of protective clothing.

Written public notification will provide information about the schedule for pesticide treatments and applications, and specific precautions that residents should take to avoid excessive exposure, such as remaining indoors during malathion or spinosad bait spray applications, or diazinon soil treatments, and that malathion-treated produce should not be harvested for 3 days after application. However, individuals with greater sensitivity to cholinesterase inhibitors or the protein bait may need to take extra precautions to avoid even minimal exposure. All oral and written communication to the public should be provided in English and Spanish to prevent misunderstandings and to minimize risk.

The program, properly implemented, represents a relatively low risk to human health except for extremely sensitive individuals who have had problems with similar programs in the past. However, this assessment does contain uncertainties associated with toxicity data gaps and estimations of exposure. Furthermore, synergistic interactions between the pesticides, which could be used in this program as well as other pesticides not associated with the program and possibly used in the same area, could increase toxicity and the associated risk. Potential risk will be substantially diminished due to the localized nature and short duration of the program.

Risks to nontarget organisms can be reduced by limiting exposure. If aerial applications are conducted, beekeepers and backyard pond owners should be notified. A survey of water bodies within the treatment area should be conducted and mapped so they will be avoided by establishing "no treatment" zones during aerial operations. Ground application of malathion or spinosad bait spray poses little direct risk. Pet owners should be notified to limit animals' exposure to treated trees. Soil treatments pose more risk due to higher toxicities. To limit exposure, a barrier or other safeguards should be used. Timing of the treatment should be considered to reduce exposure. Standard operating procedures for methyl bromide fumigations include fencing or roping off the fumigation and aeration area, which precludes exposure of many vertebrates.

The FWS will be consulted if the program area is expanded to ensure that endangered or threatened species are not adversely impacted.

Appendix A. References

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Appendix B. Consultation

The following agencies were consulted during the preparation of this environmental assessment:

Texas Department of Agriculture
P. O. Box 12847
Austin, TX 78711

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Program Support
Riverdale, Maryland 20737

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Policy and Program Development
Environmental Services
Riverdale, Maryland 20737

Finding of No Significant Impact
for
West Indian Fruit Fly Cooperative Eradication Program
Lower Rio Grande Valley, Texas
Environmental Assessment
October 2000

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), has prepared an environmental assessment (EA) that analyzes potential environmental consequences of alternatives for eradication of the West Indian fruit fly, an exotic agricultural pest that has been found in the Lower Rio Grande Valley of Texas. The EA, incorporated by reference in this document is available from–

U.S. Department of Agriculture	or	*U.S. Department of Agriculture*
Animal and Plant Health Inspection Service		*Animal and Plant Health Inspection Service*
Plant Protection and Quarantine		*Plant Protection and Quarantine*
Program Support		*Western Regional Office*
4700 River Road, Unit 134		*9580 Micron Ave., Suite 1*
Riverdale, MD 20737-1234		*Sacramento, CA 95827*

The EA analyzed alternatives of (1) no action, (2) nonchemical control, and (3) integrated program (the preferred alternative). Each alternative was determined to have potential environmental consequences. The integrated program was preferred because of its capability to achieve the eradication objective in a way that reduces the magnitude of those potential environmental consequences. Program standard operational procedures and mitigative measures serve to negate or reduce the potential environmental consequences of this program.

APHIS has determined that there would be no significant impact to the human environment from the implementation of an integrated program, the preferred alternative. APHIS' Finding of No Significant Impact for this program was based upon the limited nature of the program and its expected environmental consequences, as analyzed in the EA. In addition, APHIS considered the potential effects on endangered and threatened species and their critical habitats, and has concluded that the program would have no effect. I find that the integrated program alternative poses no disproportionate adverse effects to minority and low-income populations and the actions undertaken for this program are entirely consistent with the principles of "environmental justice", as expressed in Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations."

Lastly, because I have not found evidence of significant environmental impact associated with the proposed program, I further find that an environmental impact statement does not need to be prepared and that the proposed integrated program may be implemented.

/S/
Joe Davidson
State Plant Health Director, Texas
Plant Protection and Quarantine
Animal and Plant Health Inspection Service

10/16/00
Date